**Atmospheric
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Techniques**
Discussions

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Interactive comment on "A relative humidity profile retrieval from Megha-Tropiques observations without explicit thermodynamical constraints" *by* R. G. Sivira et al.

Anonymous Referee #1

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This paper describes clear-sky retrievals from instruments on the Megha-Tropiques satellite: SAPHIR, with six channels around the 183 GHz water vapor line and MADRAS, with five channels between 18 and 157 GHz. A statistical retrieval approach, using a Generalized Additive Model (GAM) is utilized. The authors compare the vertical sensitivity and overall performance of joint SAPHIR-MADRAS retrievals to SAPHIR-only retrievals, an important consideration, due to the fact that MADRAS data are only available for a portion of the Megha-Tropiques mission. Results from the retrieval are validated against a dataset of radiosonde humidity measurements. The authors also compare the results from the Generalized Additive Model approach to tests using other

statistical approaches, namely the Multi-Layer Perceptron (MLP) and the Least Square Support Vector Machines (LS-SVM) techniques.

In general, the paper offers useful documentation of one possible approach to retrievals of water vapor profiles from the Megha-Tropiques mission. The subject matter is appropriate for AMT and the results merit publication. However, as it stands, the paper could benefit from additional clarification and possible restructuring in certain places. The manuscript would also benefit from copy-editing from an English language perspective.

Major comments:

The authors might wish to reconsider the title of the manuscript. Without having read the article, I personally would not know what was meant by "without explicit thermodynamical constraints". In my mind, the fact that the authors use a "statistical" (based around a training dataset") as opposed to a "physical" or "variational" (involving fitting of forward modeled radiances/BTs) retrieval approach is not what is novel about this work. Perhaps there were points that I missed. If the authors feel that the title should stay the way it is, then I would suggest providing further clarification of what "without thermodynamic constraints" means and why this is an advantage. (Is it an advantage in terms of retrieval accuracy? In terms of ease of scientific utilization of the resulting retrieval products?)

The paper could be improved by providing greater clarity regarding placing this work in the context of other work in the field. The authors state in the introduction that "Many retrieval approaches exist, but to our knowledge, none of them estimate the RH profile from a simple input dataset restricted to the BTs". There are published approaches that estimate RH profiles from the BTs. These approaches, like the approach presented here, rely on some training dataset. Therefore, it is important to place this work in the context of other work. If the authors' statement still stands, it would be good to see some further justification of what advantages this method offers over what has come

before.

The authors might consider referencing the work of Soden and Bretherton, who first applied a simple BT relationship to retrieve upper tropospheric humidity from GOES thermal IR radiances, and Buehler and John (2005), who applied this approach to AMSU-B. Granted, these were not retrievals of profiles. However, other teams have certainly used statistical approaches for profile retrievals. For example, a neural network approach is applied in operational retrievals of temperature and water vapor from the AIRS/AMSU instruments on the NASA Aqua satellite (Blackwell, 2005; Blackwell and Chen, 2006). If the authors feel that it is not appropriate to compare their approach to the one taken by the AIRS/AMSU team, it would be good to see some clear explanation of why this is the case.

Considering that Megha-Tropiques is an Indo-French mission, and that the Indian team(s) have also published on water vapor retrievals from SAPHIR, I was surprised not to see references to any of that work.

The authors might consider moving the relatively detailed discussion of the three different statistical methods out of the introduction and into Section 3 (Description of the non-linear models). My expertise is not in statistical methods, and I found that the latter part of the introduction led me to expect a paper with a focus on statistical methods. Many of the potential audience for this paper would not be experts in statistical methods either. Since the details of the three different models are not a main focus of the paper, it would make sense to move this later in the paper and keep the introduction more focused on the points that the authors regard as the main point of the paper.

Could the authors clarify what constitutes a neural network? Are the three approaches outlined here considered neural network retrievals?

The conclusions section would benefit from revisions. The authors state that "The novelty lies in the implementation of the LS-SVM modeling technique". I was confused by this. I thought that the LS-SVM was only used here as a comparison tool for

the GAM approach which is to be used in the retrievals? The discussion of how the oceanic/cloud-free study has been extended to continental cases does not belong in the conclusions section. It should be discussed somewhere before this.

Minor comments:

Page 8985, lines 23-27: I would suggest just saying that measurements of the global distribution of water vapor have been made by measurements in the thermal IR and the microwave, but avoid mentioning specific examples in vague terms. (The EUMETSAT satellite carry both infrared (IASI) and microwave (MHS) instruments.)

In Figure 1, the profiles of the weighting functions are cut off before the box that shows the mean RH of the top layer.

In Figure 5, it would be helpful to see a uniform color scale. Also, the individual plots are smaller than postage stamps, making it difficult to read them.

Page 9000, line 14: Could the authors explain somewhere how a neuron is defined in this context?

Typos:

There were various mistakes that could be caught by a spell-checking tool. I have not tried to list them all, but have noted a few below.

Page 8984, line 3: "plateform" should be "platform" Page 8987, line 1: "independant" should be "independent" Page 9005, line 12: "theoritical" should be "theoretical"

References:

Blackwell, W. J., A neural-network technique for the retrieval of atmospheric temperature and moisture profiles from high spectral resolution sounding data, IEEE Transactions in Geoscience and Remote Sensing, vol. 43 (11), pp 2535-2546

W. J. Blackwell and F. W. Chen, Neural network retrieval of atmospheric temperature

and moisture profiles from AIRS/AMSU data in the presence of clouds, Proc. SPIE 6233, Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XII, 62331E (4 May 2006); doi: 10.1117/12.664712

Soden, B. J., and F. P. Bretherton, 1993: Upper tropospheric relative humidity from the GOES 6.7 μm channel: Method and climatology for July 1987. J. Geophys. Res., 98, 16669–16688

Buehler, S. A., and V. O. John (2005), A simple method to relate microwave radiances to upper tropospheric humidity, J. Geophys. Res., 110, D02110, doi:10.1029/2004JD005111.

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